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ABSTRACT

From a European perspective, this paper focuses on a set of issues affecting the emerging information economy. Among the issues covered are: developing a means of measuring the value of information and knowledge; studying other institutions such as the United States Department of Defense and the United States venture capital industry which are more advanced in recognizing the value of intellectual property; the convergence of the computing and communications industries into one digital world of information engineering; the possibility that information technology products like computers and switches will become polarized into high volume capital intensive low margin production activity and know-how intensive intellectual design activity; the role of information engineers within organizations in adding value to the enterprise by ensuring that relevant data--both internal and external--is transformed into information that can be shared by all involved in the decision making processes relevant to the organization; the need for standards and a pro-active approach to intellectual property rights; and the basic problem of information access. The paper concludes with some recommendations to be considered by the information industry, its users, and the government. (THC)

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THE INFORMATION ECONOMY - A EUROPEAN AGENDA

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THE INFORMATION ECONOMY - A EUROPEAN AGENDA

1. Our world economies are polarising into capital intensive production activities - and information or knowledge based activity. I believe this is equivalent to, and as important as, the "division-of-labour" phenomena that characterised the industrial revolution.

2. The chip industry presents an interesting, and recent example of the dramatic changes taking place. Intel and Motorola dominate the world micro-processor market - with over 90% shared between them. In '83 they were suffering from several Japanese suppliers - euphemistically reverse engineering their products. The US industry pursued the application of copyright law to patterns on chip - which the justice department has now agreed, and both Intel and Motorola set off to Tokyo with their Intellectual Property Right lawyers to negotiate. I suspect to their surprise - they both now have three Japanese sources with royalty payments of several tens of dollars apiece on chips which have an inherent production cost of only a few dollars. The Intellectual property - the information or knowledge content - is deemed to have greater value than the total material, labour and overhead content of the production process.

3. What do we mean by the word "production" in this case? Most of you probably think of large factories with thousands of people - but lets explore briefly a state of the art chip factory with 1985 levels of robotic operation.

4. A single production module of less than 10,000 sq.metres will cost $100M in capital, employ 200 people, and produce 10 million 256K memory chips per month.

5. At $10 an hour labour rate - this is 3 cents a unit. At a 14% interest rate - typical of Europe - the capital carrying cost is 12 cents/unit. At Japanese interest rates, which for members of the favoured club, are nearer 7%, capital costs are 6 cents/unit.

6. The difference in the capital infrastructure in Japan and Europe is equivalent to twice the total labour content of the chip, but is less than 1% of the value of the intellectual content. In this case, production is no more than cost effective deployment of capital - and while European governments are busy subsidising capital to create jobs which will in turn be automated away again - they don't realise its a losing battle. Jobs don't create wealth, as long as the know-how, or intellectual property rights remain in the US or Japan.

7. But how do you value intellectual stock in the economy - particularly when the fundamental processes of intellectual improvement, such as education and training, are seen as a cost burden rather than a value added process across much of the community?

8. To help - I believe a fundamental requirement is to understand the value of this emerging information economy - and to focus on it as a distinct and separate set of issues - developing an agenda for the information industry, its users, government and the PTTs who will have a pivotal role equivalent to the roads, canals and railway systems of the industrial revolution.

So let's try and build some understanding of the information economy - and the issues it presents.

9. First, we have to develop metrics for measuring the value of information and knowledge. For instance, when Intel imparted the knowledge of how to build its microprocessor to Matra-Harris in France, what import duty was applied to the transaction? Was it in the form of papers, magnetic tapes or in expatriates heads. When the EEC Esprit projects publish their papers to be shared by the industry - what value is really shared, and what value is left in terms of know-how in the original collaborating companies? When Europe spends well over $100K to produce an engineering graduate - what are we losing when half of them end up developing intellectual property for non European companies? When one of your key employees is stolen by a competitor - how much do you write down your balance sheet by? Indeed, is it stealing? Should your employees spend 1 week or 10 weeks a year adding to their knowledge through planned education and training? When your researchers make visits to colleagues in Tokyo or Boston - and eagerly discuss their work - how much intellectual advantage is your company losing?

10. These are questions we all need to answer - including enterprises who believe themselves to be in production - as Intel used to. I predict Intel will make more revenue from licensing its intellectual property than it will producing the silicon.

11. Indeed, many people may view ICL as a computer manufacturer - but out of roughly a billion pounds of revenue - ICL's factory direct labour bill is less than £10 million. Less than 1%. We are already a knowledge based company - and developing a management style to suit.

12. I believe there are two activity areas you should study which are more advanced than any in recognising the value of intellectual property and know-how - the US Department of Defence and the US Venture Capital Industry.

13. The DOD recognises that even minute leakage of know-how can add billions of dollars to the US Defence budget to retain a balance of power. This is evidenced by the extraordinary lengths they are going to to curtail leakage - such as European nationals and companies now being banned from participating in the many DOD projects, and the withdrawal of many US researchers from international conferences as more of the total American technical effort becomes sponsored by DOD - primarily because they lack a MITI or a Department of Industry, DOD is the chosen vehicle for industrial strategy.

14. The US Venture Industry recognises that you can turn a handful of people with technical know-how into a $100M valued public company in five to ten years. The founders of such companies usually perceive themselves as future millionaires - with a crystal clear view of the value of their know-how.

15. These two examples - of technology leakage from DOD, and the venture industry - are phenomena of our time - and traditional trade; in one case internationally, the other in California, because of our unfamiliarily and unpreparedness for the issues involved. All of you are being affected by American technology export controls - and their explicit extraterritoriality. And look at how great companies like H.P., Tecktronics and Intel - all pioneers in their markets - have lost a significant portion of their key know-how to venture start-ups in the past few years.

16. I would submit that in both these cases - unpreparedness was due to lack of a formal system of values attached to know-how and the underlying information.

17. Lets explore the linkages here. Know-how or knowledge is based on the aware and intelligent ongoing use of information, which in turn is based on the transportation, manipulation, searching, massaging, arranging and presentation of data.

18. You can't have know-how without information. Information is based on data - which with convergence of the computing and communications industry into one digital world as represented by tomorrow's ISDN networks - will be nothing more than a collection of O's and I's representing all the forms of data we commonly deal with, numeric, textual, spoken and visual - or data, voice, text and image as the information technologist would say.

19. Clearly, a lot of value added is going on between the processing and transportation of O's and I's at the lower level - which is where today's information technology, or production oriented economy is focussing - and the higher levels of information and know-how.

20. Know-how is, of course, of no value unless you use it. Typically, this is through the process of individual decision making, or sharing in a community - be it a company or an economy - for consensus decision making.

21. I used the word information engineering to differentiate the high value added activity from the traditional computer and communications science, or information technology activities which shuffle the O's and I's around at the Data level.

22. I believe Information Technology products like computers and switches are destined to become polarised into high volume capital intensive low margin production activity and know-how intensive intellectual design activity - just as with chips, as we discussed.

23. ICL has already recognised this by collaborating with Fujitsu - ICL designs the mainframe computers, and related chips and software, Fujitsu produces the ICL related chips and software, Fujitsu produces the ICL designed components and subsystems. The combination is formidable, believe me, but it does rely on getting the right value systems in place.

24. How many of the top architects build their own bricks? Are you likely to design better buildings by building your own bricks, or by having a free choice of all the innovative new building materials appearing in the market? For most of the architecture industry - the second option must be the answer. We see the same polarisation - and surely it must be just a matter of time before individual architect designed building takes over from the mass produced offices and houses of the 70's - but what is the value added of an architect's design? Do we measure it in terms of hours of drawing,or what?

25. But back to Information Engineering. I define an Information Engineer as someone who can go into an organisation - be it commercial or government - and add value to the enterprise by ensuring all relevant data - internal and external - is effectively transformed into information which is shared by all involved in the decision making processes relevant to the organisations pursuit of its purpose.

The starting point is an understanding of organisation and strategic decision making processes - and their value contribution to the corporate mission and objectives - not computers and communications.

26. If I can draw an analogy here to the 60s, when production engineering was struggling to emerge as a profession - against the better judgement of the schools, universities, industry and the existing professional bodies - who saw mechanical sciences and mechanical engineering as the primary profession. By the time we had figured out that high value added factories had nothing to do with designing gears - and everything to do with management, organisation, information systems, zero defects and so on - vast wastelands of industry had already been created by the absence of this profession and underlying education and training capacity.

27. We face a similar choice again - either be blinded by data processing and data communications technology, where current university, industry, national and European projects are currently focussed - or force ourselves to create a new profession of information engineering, despite the vested interests.

28. I submit that we may already be producing too many computer scientists in Europe, but only a few handfuls of people who are professionally trained to go into an organisation, analyse it and put information processes and systems in place to significantly add value. We are knee deep in technology - desperately short of its practitioners.

29. What are the symptons? I have worked in this industry all my life - but it never fails to amaze me that the basic elements, be it a logic gate or memory cell, a unit of computer power, or a line of software, are on a times ten every five years price performance curve - equivalent to a 60% real price reduction every year. The underlying technology for accessing, storing and transmitting information has been doing this for 30 years, and activity in the labs today will ensure this goes on at least till the end of the century.

30. But all of you work for organisations with data processing or information systems departments. How many of you can honestly say the value added from your infomation systems is on a much better than 15 to 20% per year price performance track - not much ahead of inflation. Clearly, there is a huge gap developing - which in turn is a huge opportunity.

31. But something must be pretty wrong with our industry to have let this gap happen.

32. First - in the 70s, we let the high priests of the software and VLSI design world get away with their mystique for too long. Too much craft and cottage industry - not enough engineering.

33. This is now about to be changed dramatically with computer aided design techniques set to increase the number of VLSI designers from a few thousand to hundreds of thousands, and in parallel software engineering techniques about to allow all thoughtful users to develop their own information systems - with actual code being produced automatically.

34. Another bottleneck is also being removed in a hurry - the over regulated telecommunications industry which has frustrated innovation and major cost reductions. Clearly, new transmission technology and new competitors will allow dramatic catch up in this area towards the end of the decade.

35. But are these problems, and the missing profession of information engineering the only bottlenecks - or are there more, preventing Europe participating fully in the future information economy?

36. I believe the answer to this is No. Our industry also needs standards - and a pro-active approach to intellectual property rights, both their use and abuse.

37. But lets discuss information a little more - and why it is so important.

38. The rate of change in our world is increasing with greater complexity, turbulence and uncertainty. Much of this change is being played on a global basis with few of us able to exercise global influence as we could when these issues were national.

39. Yesterday's management was about who you know - I submit that tomorrow's management will be about what you know.

40. Information will be the raw material of management - information is the engine of change.

41. Information is power.

42. Information on the economy, your industry, your competitors, your suppliers and customers, their skills, productivity, products, distribution channels, product life cycles, technology and so on.

43. In most cases you need global information, and you will need to know the rate of change of the parameter you are studying - because you will only improve the relative performance of your organisation by changing as fast as, or faster than, the market.

44. We are talking global competition here, not niche players, so we are discussing accelerated change in big organisations, and the essential role information must play in this.

45. We are talking about getting the price performance of your information system or knowledge base on a times ten every five years track - to close the gap with the underlying technology. This is what ought to be possible.

46. Yesterday's manager was intuitive, based on feel and experience with limited information. With low rates of change and little turbulence, together with an ability for major companies to affect their national environment - this system worked well, and it was always easy to catch up, to be a good follower.

47. But tomorrow's manager will have to make decisions with facts not assumptions. He must know how to go about getting the information, to assess its cost and value, with its timeliness and quality. He must make analytical decisions that he knows are right - but realising that good analyses can still be aided with good experience and good intuition. His judgement must be fiercely time dependent - the X axis of change. Time is one of the few things that money cannot buy. Time is of the essence when dealing with change - and this is a cultural challenge for us, because high quality, fast information tends not to come cheap. Our culture and balance sheets say information and know-how ought to be free. Free education, libraries, directories, governing statistics, academic lectures, economic

newspaper articles - all encourage us to put low value on information. We all resent enormously paying consultants $1,000 plus a day for specialist information or know-how.

48. Most large companies today have more people worrying about reducing the number of xerox copies they make, than they do working on getting high quality, fast, internal and external information to the relevant decision makers throughout the enterprise. You need to create an information engineering activity to address this - even a V.P. for Information Resources. Yet many companies still have to make the step of bringing together their data processing, office administration and telecommunication activities under one activity - let alone worrying about the information needed to <u>win</u> in their business.

49. The information industry may be in its infancy - but think for a minute.

    Every single day there are 6K scientific or technical articles produced. By 1990, this will be 50k/day. The biggest problem researchers face today is not the experiment, but to find out if its been done before.

    Out of every 100 new ideas in your organization, it is highly likely that 99 have already been had by other people.

    The amount of data being collected by governments is doubling every six years.

    Hundreds of computerised data bases are now available. This will soon be thousands.

    Every ten years we produce as much printed material as in the whole prior history of mankind.

    Access to the information is the key issue, not supply - I believe, and this brings me back to the two bottlenecks remaining, both of which are to do with accessing information.

50. International standards, to allow a free market for information and related products, and a thoughtful approach to intellectual property rights to allow a proper value to be placed on information and know-how, but without risk of abuse resulting from dominant market position.

51. Yesterday's manager used to get 80% of his information from within his own unit, 15% from other parts of his company, and 5% from outside the company.

52. Tomorrow's manager will have much of his information coming externally from many different sources. It follows that standards for information and know-how transfer - not just moving O's and I's, but value added information, are critical in this scenario. The structure of companies and society will change - with information flowing horizontally in networks that will deliver what top heavy bureaucracies never quite managed to achieve. Access to information though networks will bring power to people and countries, and as information moves through the networks, additional knowledge will be added. This is the fundamental raw material of the information economy - hence the new term Value Added Networks, or VANS.

    Let's study the basic process of information access.

53. The digital networks basically only transmit O's and I's reliably, and it doesn't care if the O's and I's represent data, voice, text or images - and it doesn't know the content. It is like a pipe - what goes in one end comes out the other, be it satellite, cable, fibre or radio.

54. The value added comes in the storage, accessing and presentation of the information at either end of the network, how the user device - normally a micro or mini computer carries on a value added dialogue with the information service processes - independent of the network. I prefer to call this an information architecture to distinguish it from a network architecture which moves O's and I's, although IBM's SNA, or System Network Architecture, confusingly spans either or both depending on the context.

55. Clearly, in the future, all micros, minis, office and factory equipment will be connected in networks, unlike the 70s when these products were standalone, within their own islands of information. To move information around multi site companies, and freely around the information economy - the users equipment must adhere to the same standards as the information providers equipment - and that is where the International Standards Organisation Open Systems Interconnect comes in.

56. There is now a set of information architecture and network architecture standards adopted by all the European industry, and an increasing number of US suppliers - which allow value added information access in networks comprising equipment from many different suppliers.

57. This is a distinct change from the past, when IBM monopolised network architecture as a result of owning 92% of all the mainframe software - which, of course, tends to be at the centre of today's networks.

58. Since IBM does not make available advance information on its SNA architectural interfaces, and it typically takes European industry 2 years to follow SNA while the information architecture portion of SNA is changing annually, it follows that when new versions of this SNA are implemented on the mainframes, only IBM's micros, minis and office systems can immediately provide the improved levels of associated price performance, because only IBM products all know the future of SNA two to three years out.

59. As a result of this, IBM's mainframe monopoly can be transferred to all computers connected in the networks - clearly a most undesirable and unhealthy situation.

    Users normally use an old version of SNA, say 1982 vintage, so they can have several suppliers - or they rely on a single vendor, IBM - unable to exploit the benefits of innovative small suppliers or of multiple competing major vendors.

60. Maybe this is one of the things that has been wrong with our industry - the GAP I talked about?

    It is vital that we understand the complete issue here - let's look at IBM's joint venture with Merrill Lynch to enter the financial services business - this is a value added information business on a global basis.

61. Here the information service provision is on an IBM mainframe - but the new service which will be delivered by satellite to appear as an image on the

new 3270 PC will make extensive use of a new version of SNA to be announced in '85. The controller, with its ability to handle four simultaneous hosts, the graphics used on the PC windows - and the compression algorithm used to display Scanmaster sourced brokers briefs - are all proprietary to IBM and unpublished.

62. This new service will only run on IBM equipment in the near term, since the SNA features required to give it price performance are only known to IBM - giving a two year lead over competitors in the financial services industry. In the past, yesterday's manager wouldn't have been too bothered with this - but tomorrow's manager, sensitive to the rate of change, and the price performance potential of a two year lead, should be most worried by this.

Today - he has an alternative - international standards.

63. The Midland Bank, one of the UK's larger banks, has already made the landmark decision to use ISO Open Systems for its own MidNet network, and European governments increasingly will make procurements to these standards.

64 Now the Federal Communications Commission has allowed IBM to take control of SBS Satellite Business Systems, and eliminated the need for arms length marketing - the European information economy has a formidable new competitor with global delivery of information services, which - as we have seen - can be integrated with the proprietary characteristics of SNA to the detriment of a free market in information services and equipment.

It is therefore essential that the information infrastructures across Europe adopt international standards and to avoid totally counter-productive "divide and rule" approach seen to date on videotex, cellular radio and direct broadcast satellites - the European information industry must get its act together on standards - and persuade the rest of the world to follow.

65. We cannot allow a monopoly in mainframes to be converted into a monopoly across the entire information economy, in particular PTT's need to be particularly stringent in their insistence on international standards - to ensure they don't unwittingly get SNA based infrastructure compromising their networks.

66. If we draw an analogue with the opening discussion on Intel and Motorola's dominance of the microprocessor market - allowing them the benefit to licence the use of their intellectual property rights in the processor chip so that others can gain profits from making the products - you should note that both Motorola and Intel made a policy of announcing two years ahead of availability of new chips the physical and software interfaces to their central processor chip so that other suppliers in the industry can develop fully co-operating specialist chips - thereby broadening the appeal and innovation at the total multi-chip system level - and putting multi-chip microprocessor based systems on a times ten every five years track.

Many Intel central microprocessor based systems will have NEC graphics chips, AMD modem chips, Western Digital disc controller chips and so on. Without full disclosure of interface information - and multiple supply of licenced chips - the industry would be very much less vigorous.

67. In contrast - the world of network and information architectures - where

we have multi computer networked systems similar to our multi chip system - the software information for the central computer is not licenced to alternative suppliers, as evidenced by the many lawsuits of the past year, and the future interfaces between computers are not made available till first shipments are made. We also have one dominant supplier - not two competing ones.

68. Maybe this is one of the contributory concepts of the gap we noted earlier? I certainly strongly believe so.

IBM networks using most recent SNA typically only have IBM computers in them. They will never achieve the overall cost performance of a true multi vendor open system network with full competition on each and every computer purchase.

My comments should not be interpreted as anti IBM - IBM sits on all the international standards committees, and is as able - or possibly more able - than any of the European suppliers to implement these standards in the best interests of their users. Indeed, now the British Government has started issuing major tenders requiring these standards - IBM is quickly complying with the bid requirements.

69. We touched on intellectual property rights again in this last discussion point - the last of my barriers.

70. These are important, because they are the mechanism for making explict the value of information and know-how - but I am afraid the rate at which our law system develops is totally inconsistent with the needs of an information economy - particularly in Europe.

Lets look at a particular example of the Apple Computer.

71. In 1980, several suppliers started building Apple lookalikes. Patent enfringements were enforced - and licensing took place covering the physical attributes of the machine.

In 1982 - new physical designs appeared in the competitive marketplace - but using the same Read only memory patterns. Copyright infringements were enforced - but without licensing - since copyright law, unlike patent law, will allow a 100% monopoly of the protected article. This probably makes sense for a work of art or literature - but does it for an industrial product?

The lookalike producers then changed the physical layout of the memory chip in '83 so it looked different, but still had the same software in it. Again, copyright laws were invoked against the software. Now - you have to query the intellectual value here - there are only a finite number of logical software approaches for recognising when you push keyboard button A, for example. Are we protecting its intellectual value, or its arbitrary uniqueness? - and this is where copyright law starts to fall down.

The last chapter of this story is 1984, when the lookalike producers started shipping Apple computer with no memory chip or software included - they were defunctional computers. Now the infringement has become counterfeit - and is successfully being prosecuted.

You might think that the right solution to this problem is to study closely

how the computer works, then re-engineer it so that different software produces the same results. IBM has successfully prosecuted misuse of trade secrets against companies that have done this.

The only solution is to sit in a vacuum, and try and engineer an equivalent system that will run all the application software written for the target system - without internal knowledge. This may be possible for a first generation PC. It is doubtful on a second generation PC - and I would submit it is impossible on mainframe operating systems.

72. We have a situation where the combination of trade secret, copyright and counterfeit intellectual property law can create and protect a total monopoly without any licensing mechanism.

73. With its origins in art and literature, IPR lacks the balance needed in its application to economic goods of trade - and government working parties need to be sensitive to this as they search for the right balance - allowing the intellectual value to be recognised but without underpinning monopoly of arbitrary low value designs, purely through dominant market position - and tie in of related products.

Equally, serious thought needs to go into the issue of know-how leakage - how are we going to treat key employees who migrate from one country to another, or from large industry to small, under the lure of venture capital. I submit that Europe could not withstand a rapid transition to Californian venture style know-how movement with its present Intellectual Property Practices.

74. So what is my agenda for the players in our industry?

75. First - be explicit about the value of information and know-how in your enterprise or economy - and separate it from your production and distribution assets.

Second - be explicit about the value added through education and training, and forcefully create the new profession of Information Engineering and the new management position of Director of Information Resources.

76. Shift university education and national initiatives towards Information Engineering - recognising that we are not technology limited in closing the identified gap.

77. Sensitize yourself to the growing information barrier around US, DOD - recognising that intelligence and command and control systems needed to run a defence system are not that different from information systems needed to run an economy or a company. Much of the US national effort in this area is being executed through DOD - unlike the fairly open initiatives in Europe today.

78. Be explicit about our bottlenecks - press for more liberalisation and free markets, particularly by implementing international standards for information systems in your enterprise - and particularly for any national information infrastructure like videotex or funds transfer systems.

79. And lastly, initiate a thoughtful debate about the whole Intellectual Property Rights scenario to ensure we get the right balance of protection and market freedom for products and people - and in readiness for tomorrow's venture environment, which if it is managed properly, can revitalise Europe to a degree few of us can possibly anticipate today.